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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/814,512	04/01/2004	George L. Kerber	20-010-DIV	6471

23400 7590 02/03/2005

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EXAMINER	
RICHARDS, N DREW	
ART UNIT	**PAPER NUMBER**
2815	

DATE MAILED: 02/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/814,512	KERBER, GEORGE L.	
	Examiner	Art Unit	
	N. Drew Richards	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 November 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *18-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *18-22,24 and 25* is/are rejected.

7)☒ Claim(s) *23 and 26* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *01 April 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 18, 22, 24 and 25 are rejected under 35 U.S.C. 102(b) as being anticipated by Imamura et al., "A submicron Nb/AlOx/Nb Josephson Junction," (previously made of record in the IDS filed 3/24/2004). See e.g., Figs 1 and 2. The junction structure is composed of Nb/Al-AlOx/Nb (page 1586, col. 1); the junction may have a diameter less than 1 micron (e.g., page 1587, col. 2, first and second full paragraphs and page 1588 col. 1, lines 1-2).

3. Claim 18 is rejected under 35 U.S.C. 102(b) as being anticipated by Lee et al., "RHEA Process for Fine-Geometry Josephson Junction Fabrication." (previously made of record in the IDS filed 3/24/2004).

Lee discloses Nb/Al-AlOx/Nb Josephson junctions wherein the upper Nb layer is patterned with a circular resist mask and subsequently partially etched, followed by an anodization step for forming junction areas on the order of 0.8 μm (see e.g., Fig 1 and the caption associated with Fig 5).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 18, 22, 24 and 25 are alternatively rejected under 35 U.S.C. 103(a) as being unpatentable over Imamura as applied to the claims above.

a. Assuming *arguendo* that the recitation in claim 18 that the junction contact has a stated diameter implies that junction must be circular in shape, and that Imamura does not sufficiently disclose that the junction may be circular as opposed to square in shape, the claims would not be anticipated.

b. Nonetheless, it was well known that the goal of forming Josephson junctions was to reduce the junction area to the greatest extent possible. It was also well known how to make resist/mask patterns that were circular in shape as opposed to square-shaped. It would have been obvious to one of ordinary skill in the art at the time of the invention to have made Imamura's anodization mask specifically circular in shape because for any given design scale, a circular shape would have a smaller area than a square shape.

6. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Imamura as applied to the claim 18 above, and further in view of Applicant's prior art admissions.

a. Imamura also discloses that the Nb base electrode is etched to the substrate to form the lower wiring. See FIGs 2b-2c and page 1587, col. 2. The last paragraph of page 1587 appears to indicate that the distance between the electrode isolation region and the junction contact is on the order of about (3μm - 0.7μm)/2 or 1.2 microns. Presuming 1.2 μm is too large to read on the claim limitation "*about* 0.8 μm," the claim would not be anticipated.

b. Applicant acknowledges in the specification and drawings that this distance is set by existing design rules (see e.g., FIG 7B). As such, it would have been obvious to one of ordinary skill in the art at the time of the invention to have reduced this length down to "about 0.8 μm" because miniaturization is a well known semiconductor industry goal and Applicant acknowledges that this smaller length was within conventional design capabilities.

7. Claims 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Imamura as applied to the claims above, and further in view of Kerber et al. '084.

a. Imamura further discloses that the junction is processed so that an oxide is coated there over and patterned to produce an outside contact via (see e.g., FIG 2d). Imamura does not depict various conventional portions of the structure, such as how other portions of the lower Nb electrode are subsequently insulated or contacted.

b. Kerber teaches Josephson junctions. See e.g., FIG 1 wherein the Josephson junction includes base electrode 12, tunnel barrier 14, and counter electrode

16. An interconnect layer 24 passes through via holes formed in interlayer dielectric layer 6 to contact both of the Nb electrode layers.

c. It would have been obvious to one of ordinary skill in the art at the time of the invention to have further provided an additional via through the insulating layer covering the Imamura junction which contacts the lower, base electrode because the base electrode necessarily has to be electrically interconnected to external devices in some manner, and Kerber teaches one conventional way of making electrical interconnections to the lower electrode.

Allowable Subject Matter

8. Claims 23 and 26 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

9. The following is a statement of reasons for the indication of allowable subject matter:

a. With regard to claim 23, as pointed out by applicant the Lee et al. reference and teachings therein would not inherently anodize a portion of the base electrode. No secondary reference has been found that teaches anodizing a portion of the base electrode as part of an anodization ring and thus the added limitation of claim 23 is not disclosed or taught by the prior art.

b. With regard to claim 26, this claim depends from claim 23 and thus contains the allowable subject matter of claim 23.

Response to Arguments

10. Applicant's arguments filed 11/23/04 have been fully considered but they are not persuasive.

a. With regard to the 102(b) rejection over Imamura, applicant has first argued that Imamura do not teach the anodized ring around the Al-AlOx layer (tunnel barrier layer). First, the claims do not require the anodization ring surround the entire Al-AlOx layer, merely that the anodization ring surround the "tunnel barrier layer." In the structure shown in figure 1b of Imamura, only the portion of the Al-AlOx layer directly beneath the upper Nb (counter electrode) is the "tunnel barrier layer" as that is the only portion where tunneling will occur. The Al-AlOx outside the actually tunneling region is merely an extra insulator layer. Thus, the anodization ring does surround a perimeter of the "tunnel barrier layer" as it surrounds that portion of the Al-AlOx layer that is the actual "tunnel barrier."

b. Applicant has further argued that the junction of Imamura does not have the claimed diameter, as the junctions of Imamura are square and not circular. First, the claims do not require the junction contact be circular, merely that they have a diameter of approximately 1.00 μm or less. Imamura disclose the claimed dimension. Using the term "diameter" with regard to the junction does not require the junction be circular. In fact, as defined by Miriam-Webster's Collegiate Dictionary Tenth Edition (copyright 1999 by Merriam-Webster, Inc.), a diameter is "a chord passing through the center of a figure or body" or "the length of a

straight line through the center of an object." Using this common definition for diameter we see that the square shaped junction of Imamura still has a diameter and thus still anticipates the claims.

c. Applicant further argues with regard to claim 24 that Imamura fails to teach a tunnel barrier layer disposed solely within the anodization ring. As discussed above, the "tunnel barrier layer" portion of the Al-AlOx layer is only that portion below the counter electrode where tunneling occurs. Thus, Imamura do disclose the tunnel barrier layer disposed solely within the anodization ring as claimed.

d. With regard to the 102(b) rejection over Lee, applicant has argued that Lee does not teach the anodized layer (anodization ring) surrounding the Al-AlOx barrier layer (tunnel barrier layer). This is not persuasive as Lee clearly discloses on page 3135, col. 1, lines 3-4, that the barrier layer (the entire starting Al-AlOx layer) is oxidized (by anodization). Thus, the anodization ring of Lee clearly surrounds the tunnel barrier layer as the portions of the Al-AlOx layer under the anodized top (counter) electrode are also anodized.

Conclusion

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to N. Drew Richards whose telephone number is (571) 272-1736. The examiner can normally be reached on Monday-Friday 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

NDR

GEORGE ECKERT
PRIMARY EXAMINER